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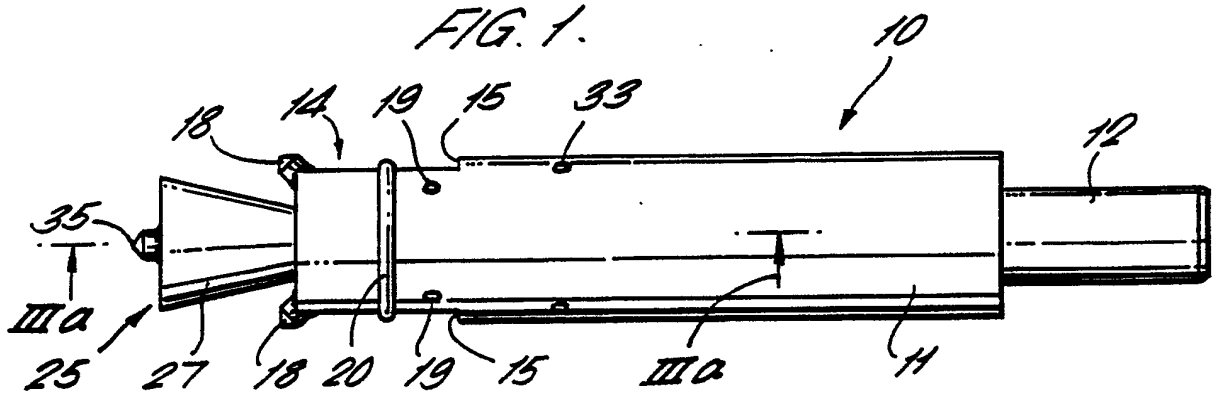
(54) Improvements in drills.

(57) A drill (10) which is expansible and retractable for undercutting holes particularly in building materials comprises a drill body (11), at least one radially extending arm (16) attached at one end to the drill body, cutting means (18) formed at an end of said arm remote from the end attached to the drill body, and guide means (26, 27) for moving said arm radially outward, said guide means being movable axially relative to said drill body. That the arm is attached to the drill body by hinge means (19) such that the arm is pivotable radially outwards. The guide means comprise a shank portion (26) and a frustoconical wedge (27). Means (20) are provided for holding the arm in contact with the guide means and means for moving the guide means axially relative to the drill, wherein the arm is caused to pivot radially outwards forming an increasing cutting diameter as said arm moves along the divergent surface of the frustoconical wedge of the guide means.

FIG. 1.



EP 0 408 379 A1

IMPROVEMENTS IN DRILLS

The invention relates to improvements in drills for undercutting holes.

Many building components such as walls, roofs etc. are required to support some form of fixing, such as a bolt or an anchor. Many such fixings are used nowadays which have an expanding sleeve or skirt, which, once the fixing is inserted into a bore in the building component, is then expanded. Expanding fixings are advantageous in that they provide an increase in the bearing strength of the fixing for a smaller contact area. Thus the fixing may be more securely fixed or a shorter fixing and shallower hole may be used.

The main disadvantage of such fixings lie in that there is only a small area of actual contact between the fixing and the walls of the bore in which it is affixed.

Some drills are now available which are capable of forming an undercut or cavity within the bore below the surface of the component. When a fixing is expanded in an undercut bore, there is a far greater area of contact between the fixing and the walls of the bore and it is far more secure.

Applicant's published patent application GB-A-2184962 describes an expansible drill for forming an undercut. The drill disclosed in this document comprises a cylinder having an incorporated cutting edge at one end. The end of the cylinder is slotted and can be expanded by tightening a nut on the end of the central shaft sticking out of the bore. This forces a frusto-conical wedge inside the slotted end of the cylinder causing it to expand radially.

The problem with this drill is that whilst it functions extremely well it is expensive to produce.

GB-B-2157207 also discloses an undercutting drill. Again in this drill the blades carrying the cutting teeth are flexible and are forced to expand radially as the body of the drill is forced over the conical guide. The latter is effected by pushing the drill against the bottom of the bore so that the guide, which is movable axially relative to the drill body, can move no further and the blades thus slide over the guide sides and consequently are expanded. Alternatively, a collar is described which bears on the outer surface of the material having the bore. The collar is fixed to the lower half of the drill body, whilst the upper half is movable relative thereto in an axial direction.

The retraction of this drill relies on the recovery of the blades which have been forced to expand. If this were not to happen, perhaps due to fatigue or excessive friction the drill would be useless. Additionally the bore would probably be wrecked whilst trying to extract the useless drill. It has been found that the drill is also difficult to use because of the force required to expand the blades. The friction caused by the blades moving over the cruciform guide is quite substantial and prevents ease of use. Also the length of the drill required to ensure that that upper and lower parts of the drill body are movable relative to each other make the drill cumbersome and difficult to use.

It is an object of the present invention to provide an improved drill for forming an undercut in a cylindrical bore which substantially overcomes these disadvantages.

According to the present invention there is provided an expansible drill for undercutting holes comprising a drill body, at least one radially extending arm attached at one end to the drill body, cutting means formed on said arm, guide means for moving said arm radially outwards, said guide means being movable axially relative to said drill body, characterised in that the arm is attached to the drill body by hinge means such that the arm is pivotable radially outwards, the guide means comprise a shank portion and a frustoconical wedge, means for holding the arm in contact with the guide means and means for moving the guide means axially relative to the drill, wherein the arm is caused to pivot radially outwards forming an increasing cutting diameter as said arm moves along the divergent surface of the frustoconical wedge of the guide means.

The invention thus provides a drill which is easy to use and less prone to damage than known drills and cheaper and easier to produce. The arms are not subject to fatigue and the arms are extendable without too much force.

Preferably there are a pair of arms oppositely disposed within slots cut axially in said end of the drill body.

The increased number of arms makes the cutting operation faster and easier.

Preferably the guide means is axially movable within a bore in the drill body. This makes for a compact and easy to use tool.

In a preferred embodiment the invention the guide means and drill body are free to rotate relative to each other and means may be provided for preventing rotation of the guide means when the drill body is being rotated.

Preferably the rotation preventing means include means for increasing the friction between the end of the guide means and a blind end of a hole being undercut and the friction increasing means may comprise at least one bar projecting from the end of the guide means.

The means for moving the guide means axially

relative to the drill body are preferably tooth means formed on an inner surface of said arm or arms and thread means formed on the frustoconical wedge, the tooth means being held in engagement with the thread means.

Alternatively, the means for moving the guide means may comprise thread means formed on the inner surface of the drill body and co-operating thread means formed on the shank portion of the guide means in engagement with the aforementioned thread means.

Advantageously little force is required to be applied manually to cause the arm(s) to expand. The force needed comes from the operation of the screw threads. The drills are therefore very useful for reversible drills and to retract the arms simple reversal of the drill driving means is all that is required.

In another alternative embodiment of the invention there is further comprised spring means biased to force the guide means towards said one end of the drill body such that the arm or arms are held in a retracted position in contact with the shank portion of the guide means.

Preferably the means for moving the guide means axially relative to the drill body comprise means for applying an axial force to the drill body greater than and in an opposite direction to the spring forces of the spring such that the arm or arms move along the shaft and into contact with the frustoconical wedge of said guide means.

This embodiment of the invention is advantageous in that if the arm(s) are required to be retracted immediately the force can instantaneously be removed from the drill body allowing the spring means to recover and the arm(s) allowed to retract.

Preferably means for preventing the guide means from rotating relative to the drill body are provided which allow relative axial movement therebetween.

Preferably the relative rotation preventing means comprise a pin inserted through at least one hole in the drill body abutting a flattened portion on the shank of said guide means.

Preferably there are also provided means for reducing the friction between the end of the guide means and a blind end of the hole being undercut; the friction reducing means may preferably comprise a single point projection formed on the end of said guide means.

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a side view of an improved undercutting drill in a retracted position;

Figure 2 is a vertical sectional side view of the drill of Figure 1 in an extended position;

Figure 3 is an end view of the drill of Figure 1 in a retracted position;

Figure 3a is a side sectional view of the drill of Figure 1 on the line IIIa-IIIa;

Figure 4 is an end view of the drill of Figure 1 with the means for extending the drill teeth removed;

Figures 5 and 6 are perspective views of the means for extending the drill teeth of the drill of Figure 1;

Figure 7 is a side view of the means for extending the drill bits of the drill of Figure 1 shown in engagement with the drill teeth;

Figure 8 is a part vertical sectional side view of an alternate undercutting drill in a retracted position; and

Figure 9 is a plan view of an alternate undercutting drill in a retracted position.

Referring first to Figure 1 there is shown an undercutting drill 10, which is particularly useful for reverse drills, in a retracted position. The drill 10 comprises a generally cylindrical body 11. The drill body 11 has a central blind bore 13, which is open at one end and extends along most of its length, as shown in Figure 2. At one end of the body 11 there is provided a shank of reduced diameter 12. This shank 12 provides the means with which the drill 10 is connected with the driving apparatus (not shown) to rotate the drill 10. The bore 13 stops before it reaches the shank 12 to prevent weakening of the overall drill 10.

At an opposite end of the drill body 11 to the shank 12 is the cutting end 14. In this end 14 of the drill body 11 are formed one or more axial slots 15. Positioned within each slot 15 and hinged to the drill body 11 is an arm 16. The hinge can be any suitable means, such as a coaxial hole 19 drilled through the drill body 11 and through the arms 16 with a pin 21 pushed through the hole 19. The hinges 19, 21 allow one end of the arms to swing out radially in an arc. The arms 16 are generally rectangular in cross section and are substantially the same length as the slots 15. At the opposite end of the arms 16 to the hinges 19, 21 are formed cutting teeth 18. The number of arms does not need to be limited to two; Figure 8 shows an embodiment incorporating three arms 52 in appropriate slots. The cutting teeth 53 of Figure 8 and Figure 9 are also different from those previously described. They are formed as part of the arms 52 by cutting the material away at an appropriate angle.

A rubber 'O' ring 20, or any other suitable means, is used to prevent the arms 16 from swinging out of their own accord. The ring 20 generally restrains the arms 16 so that the inner edges of the arms 16 are held in contact with the guide means 25 described below. The ring 20 must be of a

suitable material which allows the arms 16 to be extended when a suitable force is applied as shown in Figure 2, but which easily recovers its original position when the force is removed to cause the arms 16 to retract again as shown in Figure 1. The ring 20 may sit in a groove 22 in the surface of the drill body 11. In an alternative embodiment the rubber 'O' ring 20 may be replaced by a metal circlip which is capable of expanding and retracting.

The drill 10 also has guide means 25 for extending the arms 16. The guide means 25 comprise a single body having a shank 26 at one end of which is a frustoconical wedge 27. The shank 26 has a flattened portion 28 on one side extending along a part of the shank's length only. At an opposite end of the shank 26 to the cone 27 the shank 26 is not flattened and forms a projection 29.

The surface of the wedge 27 in this embodiment of the invention is preferably smooth. Any disruptions in its surface will reduce the drilling efficiency.

Positioned within the bore 13 is a compression spring 30 one end of which sits against the blind end 31 of the bore 13. The shank 26 of the guide means 25 loosely fits inside the bore 13 in contact with the opposite end of the spring 30. The shank 26 is retained within the bore 13 by means of a pin 32 which passes through a hole 33 in the drill body 11 from one side to the other, past the flattened portion 28 of the shank 26.

The pin 32 allows the guide means 25 to move axially relative to the drill body 10. The shank 26 is movable axially within the bore 13 until the pin 32 comes into contact with the projection 29 at the one end of the shank 26 or the step 34 formed where the flattened portion 28 of the shank 26 ends, see Figure 3a. When the shank 26 is moved to the end of its available outward travel the wedge 27 protrudes from the end of the drill body 11. As the arms 16 are constrained by the ring 20 they are pulled against the shank 26 in this position which is of a size to allow them to retract into the slot 15. When the shank 26 is moved to the end of its available inward travel the cone 27 is contained fully within the cutting end 14 of the drill body 11. Because the arms 16 are held in contact with the guide 25, as the wedge 27 moves further inside the drill body 11 so the arms 16 follow the shape of the guide 27 and swing radially outwards to an extended position.

The shape of the flattened portion 28 of the shank 26 and the positioning of the pin 32 are chosen to prevent the extending means 25 from rotating relative to the drill body 11. Thus as the drill body 11 is driven to rotate so is the extending means 25. To assist rotation a point 35 is formed on the end of the wedge 27 as this will contact the blind end of the hole to be undercut.

The inner surface 40 of the drill body 11 at the cutting end 14 is tapered as shown in Figures 3a and 4 so that only the arms 16 contact the guide 25 when it is moved in and out of the drill body 11. The resulting clearance between the inner surface 40 and the guide 27 ensures minimum friction and interference between component parts of the drill 10 during the undercutting process.

In operation a cylindrical hole is first drilled in the building component using standard equipment. The drill 10 is then connected to the power driving means which firmly clamps the shank 12. The drill 10 is inserted in the hole until the point 35 on the end of the cone 27 contacts the blind end of the hole.

As the drill 10 is rotated the drill 10 must be pushed axially further against the end of the hole. As the guide means 25 can move no further this causes the spring 30 to compress and the drill body 11 moves over the wedge 27 of the guide 25. As previously described this forces the arms 16 to extend outwards until the shank 26 reaches the end of its inward travel as shown in Figure 2 resulting in a conical cavity being cut at the end of the hole.

To remove the drill 10 from the hole, the pressure on the drill 10 must be released and the spring 30 recovers, forcing the guide 25 to move outwardly until the wedge 27 is out of the drill body 11. The ring 20 is then able to pull the arms 16 back into the retracted position within the slots 15 in contact with the shank 26.

A modified embodiment of the drill 10 is useful for reverse drills.

In the modified embodiment the shank 26 of the guide 25 no longer has a flattened portion 28. Instead the shank 26 has a portion of reduced diameter 45 as shown in Figures 5, 6 and 7. This diameter is chosen to allow the extending means 25 to rotate relative to the drill body 11 when the pin 32 is in position as well as governing the constraints of axial movement as in the previous embodiment.

The point 35 at the end of the extending means 35 is replaced with a friction bar 46 as shown in Figure 5. Alternatively a plurality of bars 47 may be used as shown in Figure 6 or any other combination which serves the same purpose which is described below.

The outer surface of the frustoconical wedge 27 has a shallow helical screw thread 48 cut therein. On the inner surfaces of the arms 16 are formed teeth 49 which engage the thread 48 as shown in figure 7.

In operation the modified drill 10 is inserted into a cylindrical hole until the bar 46 or bars 47 contact the blind end of the bore. When the drill 10 is rotated only sufficient force need be applied to

the drill 10 to enable the bar 46 or bars 47 to grip the material in which the bore is drilled to prevent the extending means 25 from rotating with the drill 10. As this results in relative rotation between the drill 10 and the guide means 25, the teeth 49 on the arms 16 travel along the screw thread 48 thus causing the wedge 27 to be drawn up within the cutting end 14 of the drill body 11. This in turn causes the arms 16 to swing outwards to the extended position to cut a conical shaped undercut.

When the drill 10 is to be withdrawn from the bore, the driving means must be reversed to drive the drill 10 in the reverse direction. This causes the teeth 49 to follow the screw thread 48 in the opposite direction and to effectively unscrew the cone 27 to allow it to return to a position protruding from the drill body 11. The ring 20 is then able to force the arms 16 to retract.

In another alternative embodiment of the drill 10, as shown in Figure 8 an alternative method of causing the guide means 25 to be drawn up within the drill body 11 is utilised. In this embodiment a screw thread 50 is cut into the shank 26 of the guide means 25 rather than in the wedge portion 27 and a co-operating thread 51 is cut into the walls of the bore 13. At the end of the extending means 35 there is a friction bar 54 which can be flat or preferably pointed in the same shape as the end of the drill used to drill the original cylindrical bore or it can be in the form of a plurality of bars as shown in Figure 5 or 6. Obviously the different type of friction bars can applied to any of the previously described drill embodiments.

In operation this modified drill 10 acts in the same way as that described with reference to Figures 5, 6 and 7 and the relative movement between the guide means 25 and drill 10 causes the shank 26 to screw along the bore 13 thus causing the wedge 27 to be drawn up within the cutting end 14 of the drill body 11.

When the driving means are reversed to drive the drill 10 in the reverse direction, the screw thread on the guide means 25 unscrews along the bore 13 allowing it to return to the position protruding from the drill body 11.

The screw thread 50 extends along a portion of the length of the shank 26. A dust seal 57 may be positioned between the thread 50 and the frustoconical guide 27 in the form of a single tooth or other suitable means.

Also in this embodiment of the drill 10 it can be seen that other modifications may be made. For example a bore 55 may be drilled in the shank 12 of the drill 10, and a slot 56 cut in the end of the shank 26 of the guide means 25. Thus a screw driver may be inserted into the bore 55 to turn the guide means 25 manually if the device gets stuck.

A further modified embodiment of the drill 10 is shown in Figure 9. In this embodiment the arms 16 are located within closed end slots 60 in the drill body 11.

Claims

1. An expansible drill (10) for undercutting holes comprising a drill body (11), at least one radially extending arm (16) attached at one end to the drill body, cutting means (18) formed on said arm guide means (26, 27) for moving said arm radially outwards, said guide means being movable axially relative to said drill body, characterised in that the arm is attached to the drill body by hinge means (19) such that the arm is pivotable radially outwards, the guide means comprise a shank portion (26) and a frustoconical wedge (27), means (20) for holding the arm in contact with the guide means and means for moving the guide means axially relative to the drill, wherein the arm is caused to pivot radially outwards forming an increasing cutting diameter as said arm moves along the divergent surface of the frustoconical wedge of the guide means.

2. An expansible drill (10) as claimed in claim 1 in which there are a pair of arms (16) oppositely disposed within slots (15) cut axially in the said end of the drill body (11).

3. An expansible drill (10) as claimed in claim 1 and claim 2 in which the guide means is already movable within a bore in the drill body.

4. An expansible drill (10) as claimed in any one of the preceding claims in which the guide means (26, 27) and drill body (11) are free to rotate relative to each other.

5. An expansible drill (10) as claimed in any one of the preceding claims further comprising means (46, 47) for preventing rotation of the guide means (26, 27) when the drill body (11) is being rotated.

6. An expansible drill (10) as claimed in claim 5 in which the rotation preventing means (46, 47) include means for increasing the friction between the end of the guide means (26, 27) and a blind end of a hole being under cut.

7. An expansible drill (10) as claimed in claim 6 in which the friction increasing means comprise at least one bar (46, 47) projecting from the end of the guide means.

8. An expansible drill (10) as claimed in any one of the preceding claims in which the means for moving the guide means axially relative to the drill body comprise tooth means (49) formed on the inner surface of said arm or arms (16) and thread means (48) formed on the frustoconical wedge (27), the tooth means being held in engagement with the thread means.

9. An expansible drill (10) as claimed in any one of

claims 1 to 7 in which the means for moving the guide means comprise thread means (51) formed on the inner surface of the drill body (11) and co-operating thread means (50) formed on the shank portion (26) of the guide means in engagement with the aforementioned thread means.

10. An expansible drill (10) as claimed in any one of claims 1 to 3 further comprising spring means (30) biased to force the guide means (26, 27) towards said one end of the drill body such that the arm or arms (16) are held in a retracted position in contact with the shank portion (26) of the guide means.

11. An expansible drill (10) as claimed in claim 10 in which the means for moving the guide means axially relative to the drill body (11) comprises means for applying an axial force to the drill body greater than and in an opposite direction to the spring foce of said spring (30) such that the arm or arms (16) move along the shaft (26) and into contact with the frustoconical wedge (27) of the guide means.

12. An expansible drill (16) as claimed in any one of claims 1 to 3 or 11 comprising means (22, 28) for preventing the guide means (26, 27) from rotating relative to the drill body, whilst allowing relative axial movement.

13. An expansible drill (10) as claimed in claim 12 in which the relative rotation preventing means comprise a pin (32) inserted through at least one hole in the drill body (11) abutting a flattened portion (28) on the shank (26) of said guide means.

14. An expansible drill (10) as claimed in any one of claims 1 to 3 or 12 or 13 comprising means (35) for reducing the friction between the end of the guide means (26, 27) and a blind end of a hole being undercut.

15. An expansible drill (10) as claimed in claim 14 in which said friction reducing means comprises a single point projection (35) formed on the end of said guide means.

FIG. 1.

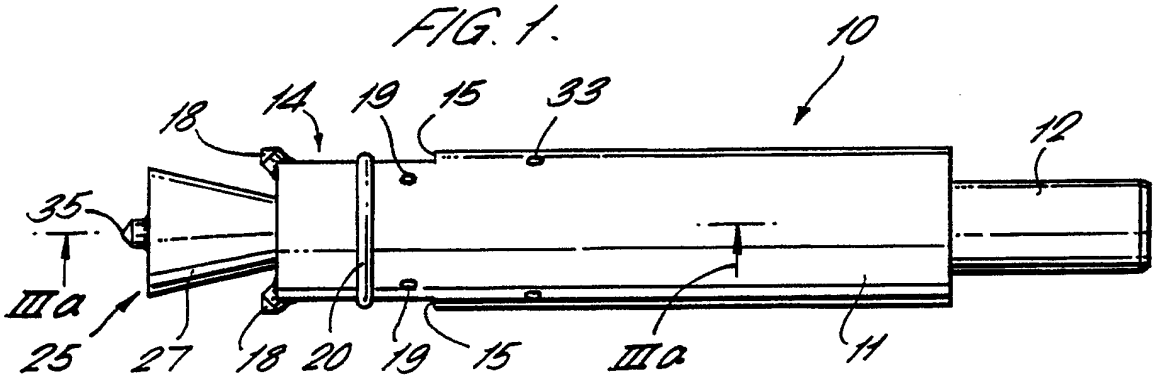


FIG. 2.

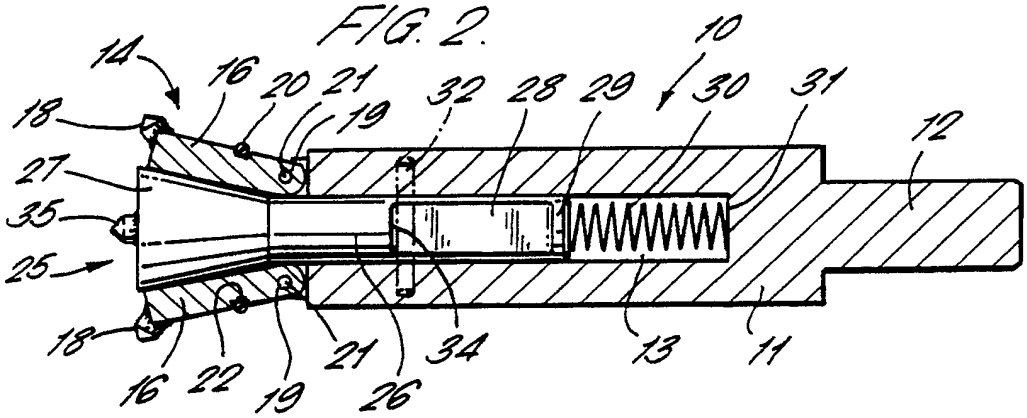


FIG. 3.

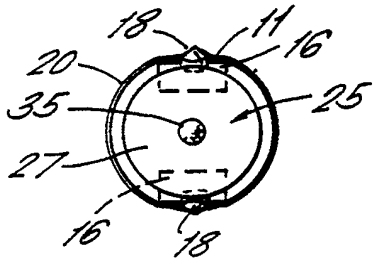
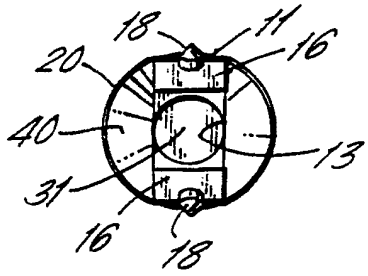


FIG. 4.



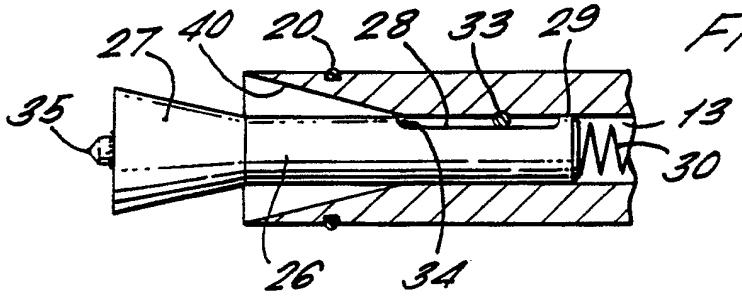


FIG. 3a.

FIG. 5.

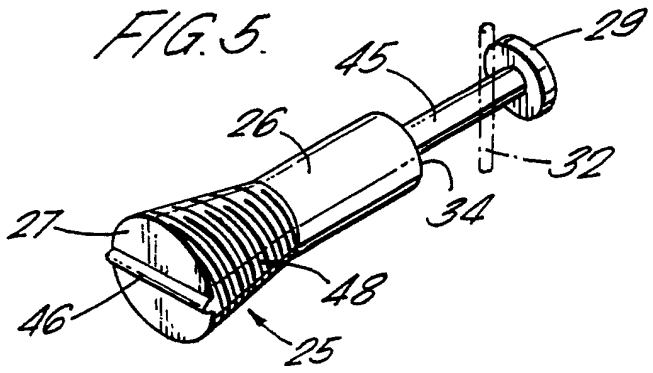


FIG. 6.

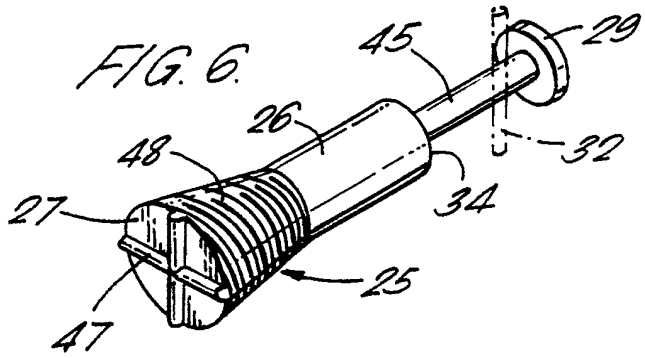


FIG. 7.

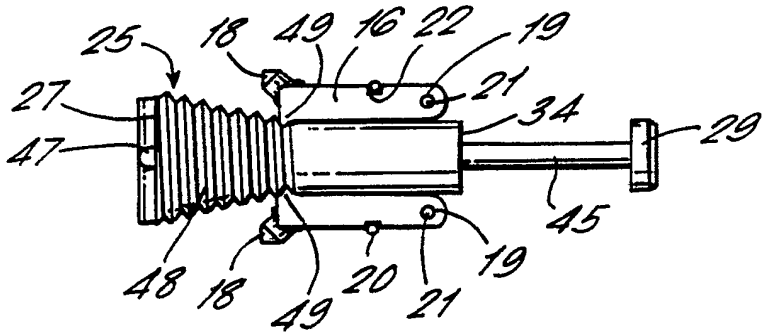


FIG. 8.

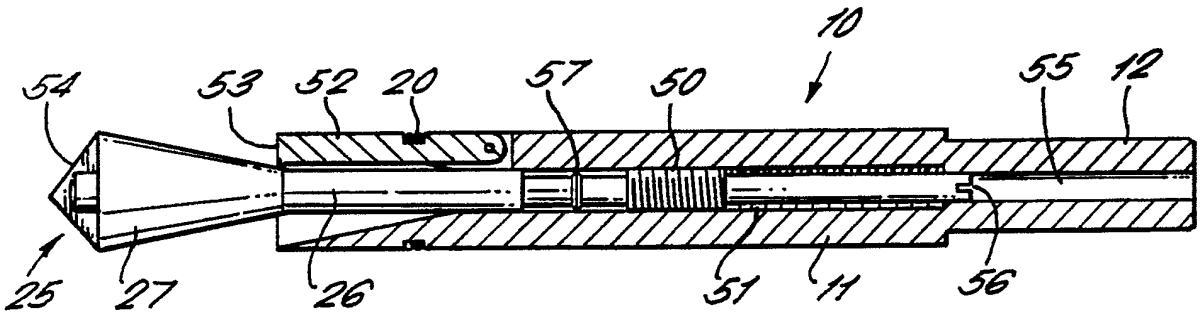
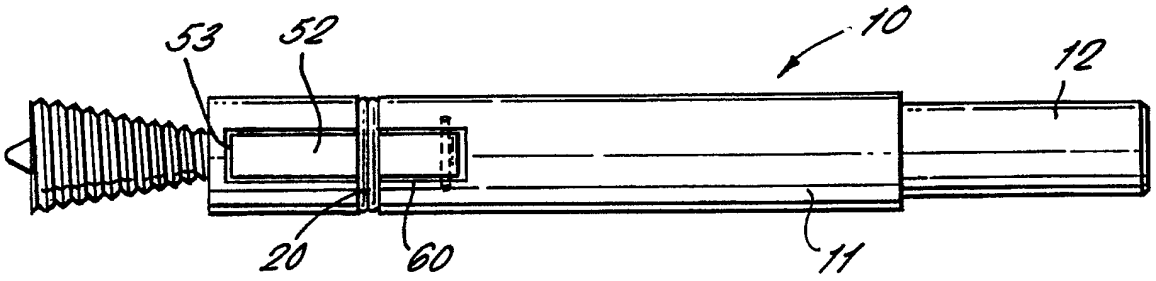


FIG. 9.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 90307675.0

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP - A1 - 0 043 000 (LIEBIG) * Abstract; claims 1-3,6; fig. 1,3 *	1,2, 10,11	B 23 B 29/034 B 28 D 1/14
X	DE - A1 - 3 300 470 (DUSS) * Claims 1-3; fig. 1,3 *	1,2	
D,A	GB - A - 2 157 207 (KABUSHIKI) * Abstract; Fig. 1 *	1,11	
D,A	GB - A - 2 184 962 (PAYNE) * Fig. 1-3; claims 1,5,6 *	1	
A	EP - A1 - 0 008 622 (BOEHM)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 23 B 29/00
B 28 D 1/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	04-10-1990	RIEDER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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& : member of the same patent family, corresponding document

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US-CL-CURRENT: 408/155 , 408/157

ABSTRACT:

A drill (10) which is expansible and retractable for undercutting holes particularly in building materials comprises a drill body (11), at least one radially extending arm (16) attached at one end to the drill body, cutting means (18) formed at an end of said arm remote from the end attached to the drill body, and guide means (26, 27) for moving said arm radially outward, said guide means being movable axially relative to said drill body. That the arm is attached to the drill body by hinge means (19) such that the arm is pivotable radially outwards. The guide means comprise a shank portion (26) and a frustoconical wedge (27). Means (20) are provided for holding the arm in contact with the guide means and means for moving the guide means axially relative to the drill, wherein the arm is caused to pivot radially outwards forming an increasing cutting diameter as said arm moves along the divergent surface of the frustoconical wedge of the guide means.